London. In the libraries of the learned societies at Burlington House alone there are many serials in duplicate; some of these might profitably be replaced by others which are not at present in these libraries. It often happens that books and serials are sent to library committees on approval, and are rejected because they are thought to be more suitable for other libraries; but attempts are not always made to ascertain whether these other libraries possess them. At the present time, from want of space and other causes, the duplication of periodicals at Burlington House is avoided as much as possible.

In the subject index to the scientific literature of the last century which the Royal Society is preparing, it is proposed to indicate, in the introductory list of serials, the libraries in which the cataloguing has been done, and also to mention other libraries in which the books may be found. This will be useful to workers, but it cannot be quite complete, for the task would be too great to undertake in its entirety. For example, there are more than 600 serials which contain mathematical papers, and it would be impossible to name all the libraries where they are found.

March 3 HERBERT MCLEOD.

The Bees of Australia.

UP to the beginning of 1905, 224 species of wild bees had been recorded from Australia, no less than 183 of them having been described by F. Smith, of the British Museum. I had the opportunity in 1904 to study Smith's types at the British Museum, and since then I have worked up the unnamed Australian material belonging to that institution, with the exception of some species of Halictus yet to be examined. The following list shows the genera found in Australia (including Tasmania), New Zealand, and the Austro-Malay Islands (taking the region as defined by Wallace), and the number of species in each.

Family.	Genus.	Australia.	New Zealand.	Austro-Malay Islands
Colletidæ	Phenacolletes *	1	—	—
	Paracolletes (sens. lat.)	52	8	—
	Anthoglossa *	4	—	—
	Cladocerapis *	1	—	—
	Andrenopsis *	1	—	—
Prosopidæ	Hylæoides *	2	—	—
	Callomelitta *	1	—	—
	n.g. aff. Callomelitta*	1	—	—
	Prosopisteron *	1	—	—
	Euryglossa *	29	—	—
	Prosopis	54	7	6
	Stilpnosoma *	2	—	—
Andrenidæ	Sphecodes	1	—	1
	Halictus	22	3	1
	Parasphecodes *	18	—	—
	Nomioides	1	—	—
	Meroglossa *	1	—	—
	Nomia	19	—	21
	Stenotritus *	2	—	—
	Andrena ?	3	—	—
Family ?	Gastropsis *	2	—	—
Panurgidæ	Scrapter ?	2	—	—
Ceratinidæ	Ceratina	—	—	6
	Exoneura	5	—	—
	Allodape	3	—	1
Xylocopidæ	Xylocopa	2	—	27
	Lestis *	2	—	—
Anthophoridæ	Anthophora	11	—	6
	Saropoda	2	—	1
	Tetralonia	1	—	—
Melectidæ	Crocisa	8	—	7
Nomadidæ	Nomada	—	—	2
Megachilidæ	Megachile	50	—	57
	Lithurgus	4	—	—
	Thaumatosoma	1	—	—
	Ctenoplectra	—	—	1
	Coelioxys	2	—	4
	Parevaspis	—	—	1
	Anthidium	—	—	1
Apidæ	Apis	(1 introd.)	—	3
	Trigona	5	—	7
		317	18	153

The list proceeds from the most primitive bees up to the most specialised. The genera marked with an asterisk are wholly peculiar to Australia, so far as known; and it will be observed that, as with the mammals, there are many endemic genera of a primitive type. Lestis is the only endemic genus allied to the ordinary long-tongued bees, and that consists of two closely allied species, which represent an offshoot from Xylocopa, probably not of very ancient date. True Xylocopa, it will be noticed, just enters Australia (but one species is common in the north), but is rich in species in the Austro-Malay Islands, and extends into Asia, Europe, Africa, and America. The Xylocopas are the large carpenter bees, which nest in wood, and may be transported across the water in floating trees. Until recently, the genera Thaumatosoma and Exoneura were supposed to be peculiar to Australia, but the first has now been found in Burma and the second in Syria. They may possibly be genera which are verging on extinction, but as each differs only in one important particular from its nearest ally (these allies being Megachile and Allodape respectively), it is not impossible that they arose by parallel mutations in the widely distant localities in which they occur, quite independently.

The most interesting of the primitive genera is Phenacolletes, based on a new species (*P. mimus*) discovered by Commander J. J. Walker on the *Penguin* Expedition. The Colletid bees are supposed to have been derived from the fossorial wasps, and Phenacolletes is so like certain wasps that I was not sure whether it was a wasp or a bee until I had examined its pubescence with a compound microscope. Unfortunately, we know nothing of the habits of this insect, but Commander Walker kindly informs me that it was taken on November 12, 1890, at Turtle Bay, north end of Dirk Hartog Island. He finds in his journal for that day that "an upright growing shrub with ovate glabrous leaves and large whitish-rosy mallow-like flowers" was the only plant which seemed to be at all attractive to insects, so perhaps the Phenacolletes came off that.

I have supposed that the bees with emarginate tongues (Colletids and Prosopids) arose from the wasps independently from those with pointed tongues, this seeming the more likely, because the wasps themselves exhibit both types. However, there are indications that in Australia the first form may have become modified into the second within the limits of the bee-group. This is especially suggested by the tongue of Callomelitta, and by one of the new species placed for the present in Paracolletes.

The new genus allied to Callomelitta, indicated in the table, is for *Sphecodes antipodes*, Smith. Colonel Bingham very kindly made a critical examination of this species at my request, and found that it was not a Sphecodes, but belonged to a new genus differing from Callomelitta in the shape of the thorax, pubescence of hind tibiæ, &c. It will undoubtedly prove an important form from the standpoint of the evolutionist.

The species marked as Andrena? and Scrapter? stand in our lists as members of these northern genera, but they have not been critically examined recently, and it is questionable whether they are rightly classified. The name Mellitidia has been applied to the so-called Andrena of Australia, and it is probably valid. Nevertheless, there are some undoubted cases of well known northern genera having endemic Australian species, while they have none, so far as known, in the Austro-Malay region. These are Nomioides (found from Burma to Europe) and Tetralonia (India to Europe, &c.); Saropoda (also European) is really in the same category, as the single Austro-Malay species is one of the Australian ones, which has reached the Aru Islands. The case of the Tetralonia seemed a little doubtful, but Colonel Bingham has critically examined Smith's type, and reports that it is a true Tetralonia, but is a female, not a male, as Smith had it. Lithurgus is also a genus of Europe and Asia, and likewise Africa, which has Australian species, though none are known from the Austro-Malay islands. In this case, it is practically certain that the genus is dispersed more or less through the islands, and has been overlooked, for one of the Australian species is exceedingly close to one of India.

Gastropsis, placed by Ashmead in the Andrenidæ, is apparently allied to the European Meliturga, and is in a

way intermediate between the two groups (long-tongued and short-tongued) of pointed-tongued bees. Cladocerapis and Prosopisteron are extraordinary endemic genera, which do not lead in the direction of anything known elsewhere.

It will be observed that the native bee-fauna of New Zealand is very poor, and quite lacking in distinction. Two of the genera are world-wide, while the third (Paracolletes) is found only in New Zealand and Australia, the species of the two regions being quite closely allied. It would seem that New Zealand received its bees in comparatively recent times from Australia (one of the species of Prosopis is even identical with an Australian one), and it may be added that all the affinity is with the southern part of Australia, especially Tasmania. There is still a possibility, of course, that New Zealand may contain some ancient endemic genus, which is now rare and has been overlooked by collectors.

The bees of the Austro-Malay islands are not at all adequately known, though we have a good idea of the general facies of the fauna. Most of the species were discovered by Wallace; I find that about a dozen were known before Wallace went to the islands, about seventy-four were added by him, and sixty-six have been discovered since. The species of Celebes are best known (41), but from Amboina we know only 9, Lombok 3, Timor 8, Ceram 3, Bourn 3, New Caledonia 4, Timor Laut 1, and so forth. It is evident that a very rich field lies before the collector in this region; but it is curious that so far we have not a single endemic genus of bees from the Austro-Malay islands, and it appears probable that few or none exist. Instead, we have numerous species of widely dispersed tropical genera; a varied, but not, apparently, very isolated fauna. The contrast with Australia is extreme. Of the eighteen genera represented, only six are even confined to the eastern hemisphere, these being Crocisa,[1] Allodape, Aspi, Saropoda, Ctenoplectra, and Parevaspis.

To sum up, it is apparent that Australia posesses a very old and long isolated bee-fauna, containing types which seem to link, in greater or less degree, the bees and fossorial wasps, the emarginate-tongued and pointed-tongued bees, and the long-tongued and short-tongued bees. It is therefore evident that the study of this fauna is likely to yield much of interest in the future; and, it must be added, there is little doubt that the number of species awaiting discovery far exceeds the number already discovered. On the other hand, we find in Australia also a more modern fauna, containing even a few species quite identical with those of the Asiatic mainland, and several closely allied thereto. Such are certain species of Nomia, Xylocopa, Anthophora, and Trigona. Of such forms, it appears that they are either strong fliers (as Anthophora) or else they have the habit of nesting in trees (as Trigona), and thus it is not difficult to understand how they crossed the sea. None of these genera, however, have reached New Zealand, which is not only too remote, but also out of the path of suitable marine currents. In the case of certain cosmopolitan genera which have numerous Australian species, such as Prosopis and Megachile, it is to be noted that only a few of the species are specially related to those of the Malay Islands and Asia; the others constitute part of the peculiarly Australian fauna, although they have not become generically altered.

T. D. A. COCKERELL.
University of Colorado, Boulder, Colorado, U.S.A.

The Intelligence of Animals.

IN his review of Father Wassmann's book (NATURE, February 1, p. 351) Lord Avebury dissents from Father Wassmann's conclusion that the sagacity of ants is "instinctive and essentially different from intelligence and reflection," and repeats the opinion which he has held for many years, that "it is difficult altogether to deny to them the gift of reason." The following incidents, which I observed on a footpath in the Donetz Coalfield, in Russia, in the summer of 1898, appear to me to show that the insects here referred to possess both intelligence and the gift of reason, and, therefore, to lend a general support of Lord Avebury's views.

Numerous small black-beetles, about three-eighths of an inch in length, were busily engaged in rolling, hither and thither, balls of cow-dung, about half an inch in diameter, which they had cut away from the edge of a still soft mass of that substance that lay near the middle of the path. As a rule, two insects were engaged in rolling each ball, both walking on their hind legs with their fore-feet resting on the upper curve of the ball—the one behind pushing and walking forwards, the one in front pulling and walking backwards. When the ball commenced to roll on any declivity it passed over the body of the one in front, which then lost its hold and was left behind. But the other always held on tightly to the ball, and was carried over and under it, several times in succession, until the ball either ceased rolling or the insect was thrown off. In the latter case the beetle followed to the bottom of the slope on foot, and usually recovered the ball without difficulty.

The principal slope upon which these disasters happened constituted one bank of a small dry water-course about six inches deep. The length of the bank from top to bottom was ten or twelve inches. The dry bed of the water-course was slightly inclined. In one instance, in which the beetle was thrown off at the fourth or fifth revolution of the ball, the latter rolled to the bottom of the bank, and then, turning at right angles to its former direction, continued to roll down the bed of the water-course to a further distance of nine or ten inches. The beetle followed to the foot of the bank, but did not find the ball where it obviously expected to do so. After hesitating and moving about in various directions to a distance of an inch or two, it ran down the bed of the water-course to a distance of three or four inches, returned, ran down again to a greater distance, returned a second time, then ran down to within two inches of the ball, but, failing to find it, gave up the quest and climbed up the bank to the level part of the path. All its movements, from the time it was forcibly parted from the ball, had the appearance of being dictated by intelligence and reason.

Again, a solitary beetle rolling a comparatively new ball had reached a distance of nine or ten inches from the heap when a second unoccupied beetle coming from the opposite direction stood up in front of the rolling ball as if with the intention of pulling it forward and assisting the first. Instead of doing so, however, it brought the ball to a dead stop. In vain the first beetle tried to move the ball; the second held it fast. The first then got down and peered round the side of the ball, apparently with the object of ascertaining the nature of the obstacle. While this examination was proceeding, the second, with its fore-feet still resting on the upper part of the ball, neither pushed nor moved in any way. The first then stood up again behind the ball and pushed it as before, but still the ball did not move. For the second time the beetle got down, made an examination as before, then, crouching with its back well under the lower curve of the ball, heaved with all its might—in the same way as a workman does in similar circumstances—but the ball remained stationary. The first beetle then came out from under the ball, and was proceeding round its right-hand side, with some new intention, when the two seemed to catch sight of each other. The second beetle threw itself on the ground with the quickness of thought, and fled pursued by the other, both running at their utmost speed. Fear, and a sense of guilt, seemed to spur the flight of the one, resentment and anger the pursuit of the other. In a chase which was continued for a distance of six inches, the fleeing beetle, which had started with an advantage of about an inch and a half, increased the distance between its pursuer and itself to more than two inches, when the former, seeing the futility of further pursuit, stopped, returned to the ball, and resumed its occupation of rolling it.

The reason why the second beetle stopped the ball, remained absolutely motionless when the other got down to reconnoitre, and ran away when it saw it was discovered is not apparent. Dare we suppose that it was simply amusing itself at the expense of the other? This was the impression left on my mind at the time.

W. GALLOWAY.

[1] Crocisa has been reported from the neotropical region, but the species are probably not correctly referable to that genus.